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URANIUM TAILINGS  
DATA BASE  
FOR  
CANMET, EMR

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URANIUM TAILINGS DATA BASE  
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## 1. INTRODUCTION

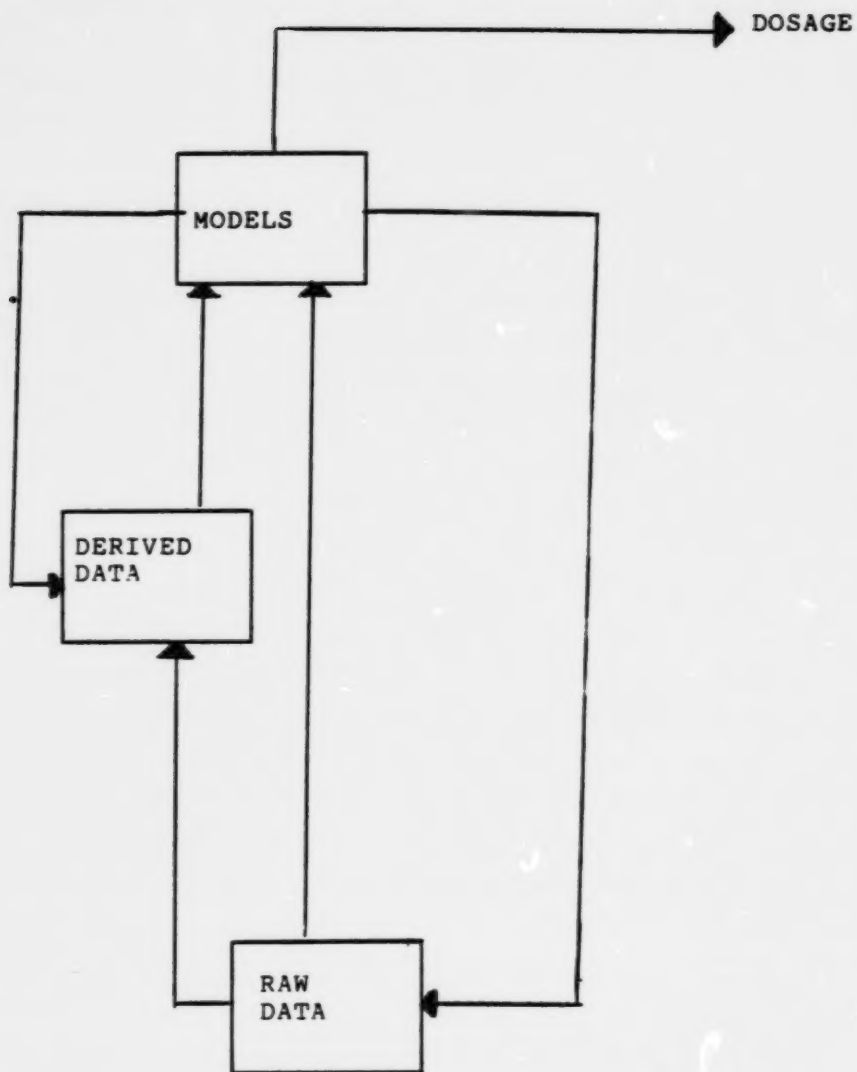
The purpose of this study is to prepare a preliminary design for the organization and content of a data base for uranium tailings data.

This study is an attempt to anticipate the requirements of the proposed National Uranium Tailings Program (NUTP) and to get a head start on the data base that will be required.

### Scope

Because of time and budget constraints the scope of this study is limited to the tailings containment facility and its contents. It is apparent to all concerned that a comprehensive data base must ultimately have a much broader scope ("a total systems approach") to be useful to those responsible for the development and verification of transport and dosage models. Therefore this report will include a brief description of the range of uranium tailings data in order to place the content of the data base described herein in context.

Within the context of the proposed NUTP the general relationship between the data in the data base and the development and use of dosage models is shown in the following diagram.



Relationship Between Data and and Models

Figure 1

### Study Description

The study was conducted by Systemhouse Limited under contract to CANMET (see Appendix C) and involved many interviews with people interested in the NUTP: the federal departments of Energy, Mines and Resources, Environment, the federal regulatory agency Atomic Energy Control Board, the crown corporations Atomic Energy of Canada Ltd. and Eldorado Nuclear Ltd., the provincial environment ministries of Saskatchewan and Ontario, the provincial crown corporation Saskatchewan Mining Development Corporation, the provincial Saskatchewan Research Council, and several private companies and university researchers in both Ontario and Saskatchewan. A complete list of interviewees is given in Appendix A.

In addition to the interviews to determine requirements, a variety of background material was reviewed to gather information on measurement variables, potential uses of the data, other existing data bases that may provide examples or guidelines, and the kinds of data available in studies. This material is listed in Appendix B.

The original contract is included in Appendix C. I would like to thank all those people who gave so generously of their time to assist me on this project, particularly those who gave me copies of papers, both published and unpublished, and other documents related to this study. Special thanks is due to Hart Horn-Johnson of Environment Saskatchewan for arranging my meetings in Saskatchewan.

## 2. DATA BASE DESCRIPTION

The data base description consists of two parts, the organization and the data dictionary. The latter part describes the individual data elements, i.e. the context of the data base.

Uranium tailings data covers many disciplines including geology, geochemistry, extraction metallurgy, hydrology, civil engineering and other environmental sciences as well as basic chemistry, physics, and biology. To understand and describe the behaviour of uranium mine tailings in the natural environment requires a truly multidisciplinary approach because of the complex interactions which can and do take place. Any segmentation or compartmentalization of the data is solely a function of convenience for the purpose of a study.

The following diagram (Figure 2) is an attempt to portray the various kinds of data which would be needed in a comprehensive, "total systems approach" to a uranium tailings data base. Five of the six boxes at the second level correspond roughly with steps in the production of tailings at which measurements can be taken and some control can be exercised over the process. The sixth box indicates that there are external environmental factors which also have an impact on the tailings. These factors include the local meteorology and hydrology, and baseline water quality.

The limitation of the scope of this study to the tailings containment facility and the tailings themselves themselves is a recognition of the importance of characterizing the "source term" for all potential contaminants. Similarly the other second level boxes contribute to the characterization and classification of the source term. Each of these boxes will be described in turn.

The source rock data consists of data on the regional and local geology, on mineralogy and rock chemistry, and on the composition of the ore.

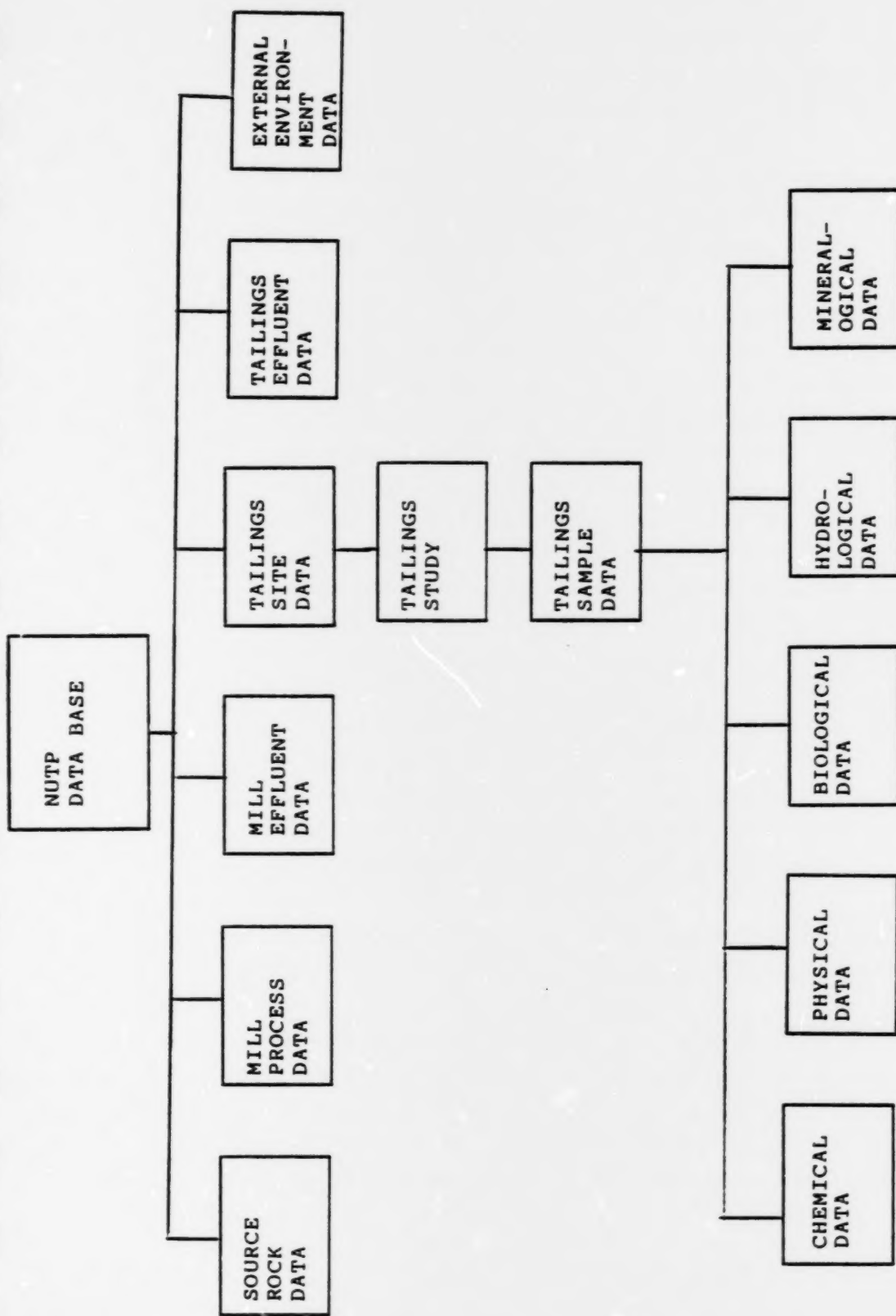
The mill process data contains a description of the mill flow sheet including grinding size, chemical treatment and a record of changes in the processing. Much of this data is already recorded for operational monitoring.

The mill effluent data records the volume and composition (pH, % solids, grain size distribution, radionuclide and non-radionuclide composition) on a periodic basis over the operating life of the mill. This will be useful historical information for reviewing the development of the tailings.

The tailings data will consist of data on the containment facility and samples of various kinds in, on and above the tailings. These groups of data will be described in more detail under section 2.1 Organization.

The tailings effluent data will be somewhat similar in kind to the mill effluent data but will consist of the monitoring data on seepage (into ground and surface water) and direct outflow into the local environment. Much of this data is already being collected for provincial and federal regulatory bodies and is readily available.

The external environment data is primarily hydrological, water quality, and meteorological as mentioned previously.



CONTEXT DIAGRAM

FIGURE 2

## 2.1 Organization

It is important that the data base organization be as flexible and "open-ended" as possible at this stage to minimize the impact of changes which will occur inevitably, as the data base is used and the nature of the interaction with the pathway analysis models becomes better defined. For this reason, the simple hierarchy (Figure 3) is deliberately made as generic as possible to allow the specific contents to be indicated by coded data elements at various levels in the hierarchy. This structure is very similar to that used in Environment Canada's NAQUADAT system although that system is intended only for surface water quality data. Since the NAQUADAT system will be a source of much of the surface water quality data and is a well established data base using System 2000 (S2K) it makes good sense to make the structure of the NUTP data base as compatible as possible without jeopardizing future refinements of the NUTP data base.

The hierarchical structure consists of four (4) levels: tailings site, study, sample and measurement. The tailings site was chosen as the basic unit because the interviews indicated that tailings waste management is best handled on a site specific basis.

At the tailings site level would be included non-repeating information about the tailings site itself such as: area, volume of tailings, general location, operations start and end dates, basement and surficial geology, mine owner, type of mill process, ore mineralogy, type of containment facility.

The study level will contain information specific to a study on one or more tailings sites. (If the study does contain work on more than one site the study information will be duplicated for the other site(s)).

At the study level will be stored such information as: study title, author, date, methodology, number of samples, and cross reference to publication.

With respect to methodology, the study description should include information on sample treatment, instrumentation, sample size, time of analysis relative to sampling, and sampling procedures. This approach has been used very effectively in the Uranium Reconnaissance Program of the Geological Survey of Canada to archive their geochemical sample data. The information in such a description is vital to determining whether two sets of data in different studies can be combined or compared. (i.e. are consistent).

For each study there can be multiple sample types and multiple samples of each type. For each sample the following information will be required: sample type, sample identifier, sample location (x, y, z, date and time), and sample description or comments.

The generic approach to the design of the data base implies that, at the measurement level, only a measurement type code, measurement value and a measurement quality indicator are necessary. At this level the "raw data" are stored in the data base, not the derived or calculated data such as transfer coefficients or flow rates, which are implicitly included at the study level in the study description.

The reason for the inclusion of the raw data and the derived data is two-fold; first, someone using the data base may wish to use raw data from several studies to perform an analysis not performed by those involved in collecting the raw data; second, if the raw data is not recorded it would not be possible to verify the derived data. An implication of the inclusion of raw data in the data base is that only the data which the person collecting it and a "data base administrator" agree is of good quality should be included in the data base.

The reason for only including the derived or calculated data implicitly at this stage rather than explicitly is because these data are closely related to the study methodology within which they were derived. It is therefore important that they not be taken out of context and be used with care by those developing the dosage models.

Future expansion and enhancement of the data base to include the other groups of data at the top level in Figure 2 will likely require redesign of the database. However the redesign is unlikely to involve changes below the study level. What will be involved is the addition of other repeating data groups at the tailings site level and lower to include source rock data, mill process data, mill effluent data and tailings effluent data. This last group could be included in the current proposed structure without adding new repeating groups.

At this time it is not recommended that the environmental data on general methodology, hydrology, water quality, demographics and wildlife be included in this NUTP data base. What is recommended is that cross references be included in the NUTP data base indicate the kind, source, and extent of these kinds of data that are available from other national and provincial sources. The reason for this recommendation is to maintain a separation between the data base and its uses until such times as the relationship between the data base and the model development program becomes clearer. This approach will provide greater flexibility in the use of the NUTP data base by a) minimizing data duplication between data bases and b) conducting the modelling process external to the data base. In addition the volume of information required to be maintained will be kept to a minimum by this approach.

URANIUM TAILINGS DATA BASE  
HIERARCHICAL STRUCTURE

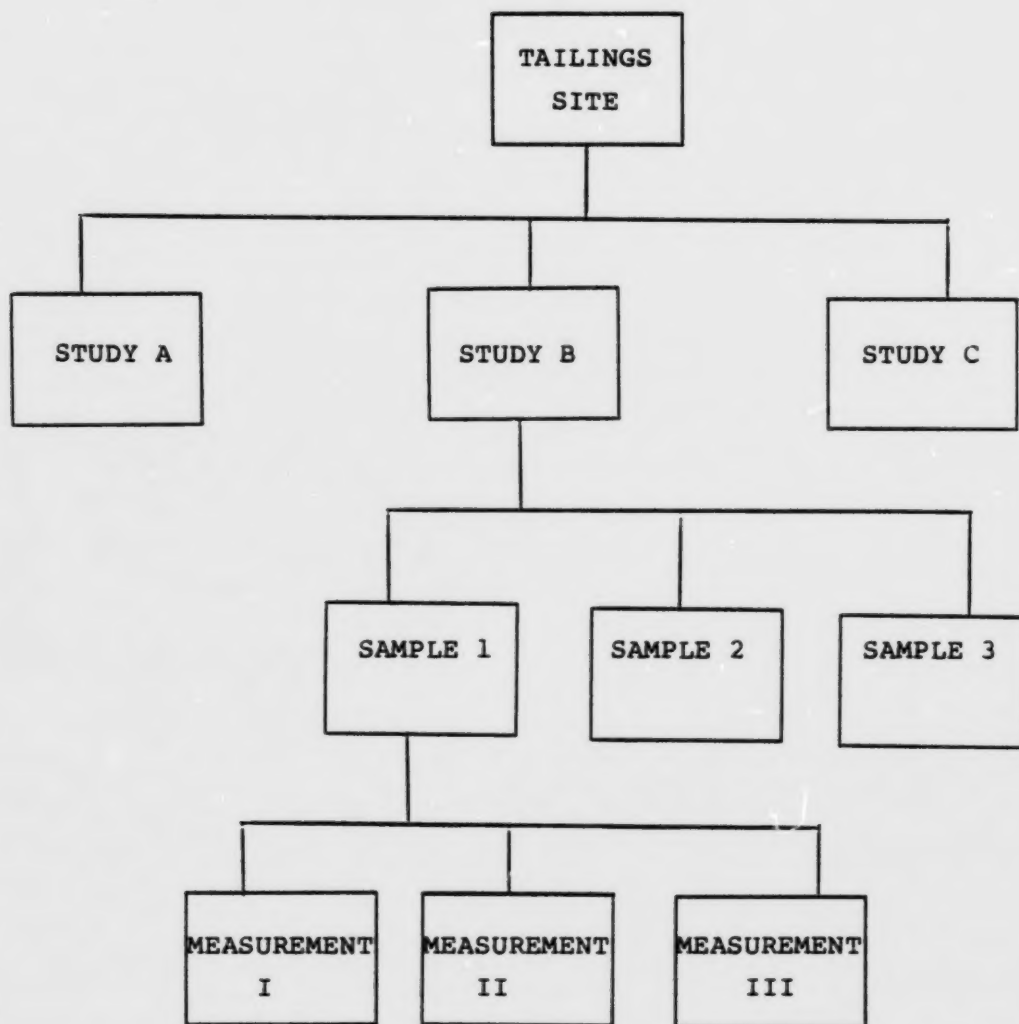


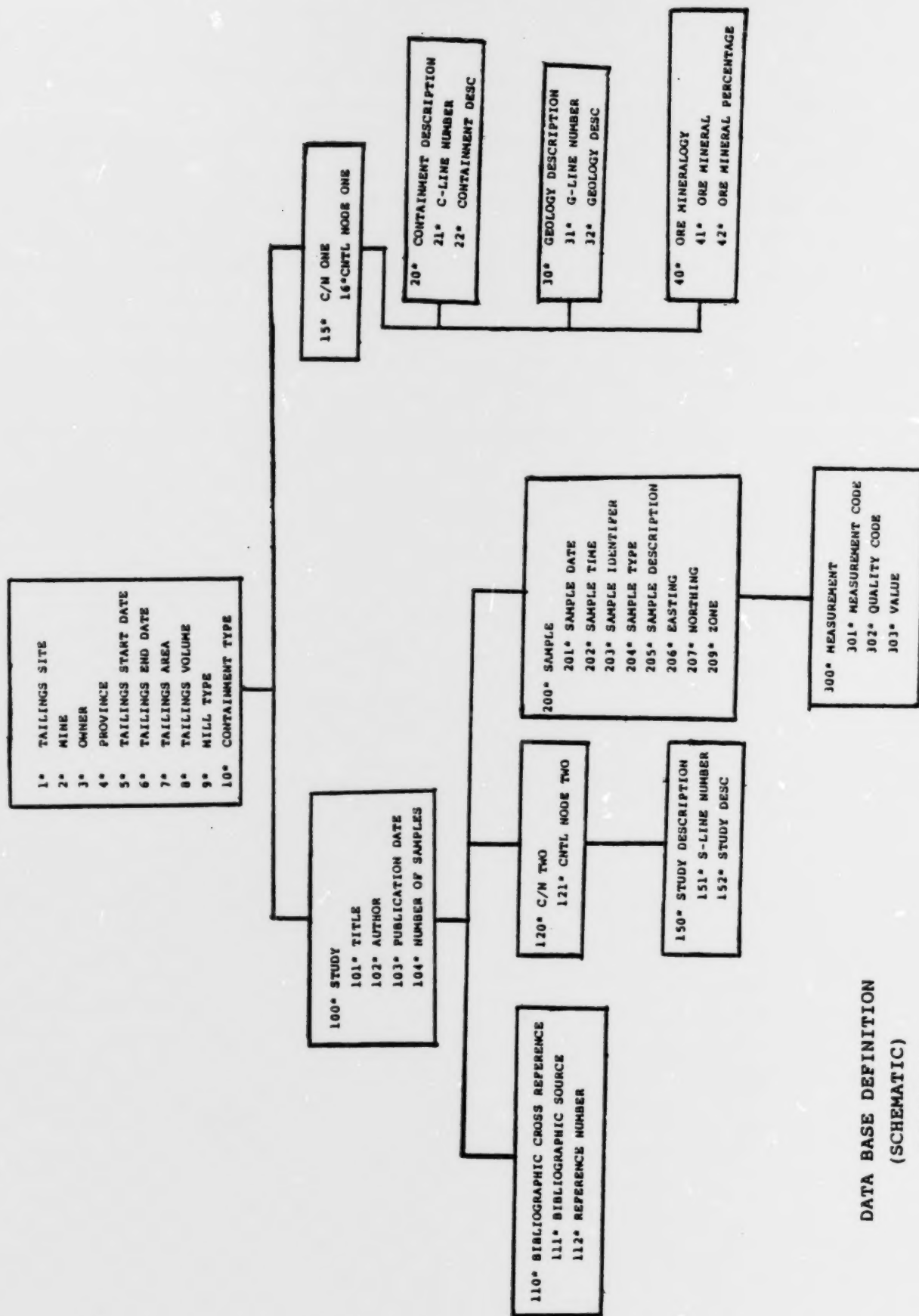
Figure 3

## 2.2 Data Dictionary

The data dictionary contains the data base definition, in S2K format, the data element definitions and tentative code lists and code structures. Figure 4 shows the database definition schematically.

Repeating groups are indicated by the word "RECORD" in the database definition. A repeating group is a set of data elements occurring together which can have multiple values. For example, a study may have multiple samples, each of which can have multiple measurements. Information at the sample level is in the samples repeating group. There can be several kinds of repeating groups at the same level and repeating groups can themselves have repeating groups. Besides indicating a hierarchical relationship a repeating group structure can be used where there is only one repeating data element but the size of the element is unknown. This is particularly useful for narrative descriptions to avoid reserving a lot of unused space. Dummy control nodes (C/N ONE and C/N TWO) were added to make retrievals more efficient for repeating groups at the same level. When changes to the data base content and organizations occur the existence of these nodes becomes very important and they may need to be changed when the database is redesigned.

Note that with this design the types of analysis would only be found in two places; embedded in the study description and in each of the measurement codes. If it is found that there is a commonly occurring need to retrieve studies which have particular kinds of analyses then it may be more efficient to summarize the analysis types at the study level as an explicit data element or data elements.



DATA BASE DEFINITION  
(SCHEMATIC)

FIGURE 4

NUTP Data Base Definition

- 1\* TAILINGS SITE (CHAR X(12))%
- 2\* MINE (CHAR X(10))%
- 3\* OWNER (CHAR X(15))%
- 4\* PROVINCE (INTEGER 99)%
- 5\* TAILINGS START DATE (DATE) %
- 6\* TAILINGS END DATE (DATE) %
- 7\* TAILINGS AREA (NON-KEY DECIMAL NUMBER 999.99)%
- 8\* TAILINGS VOLUME (NON-KEY DECIMAL NUMBER 9(5).9)%
- 9\* MILL TYPE (CHAR X)%
- 10\* CONTAINMENT TYPE (CHAR XXX)%
- 15\* C/N ONE (RECORD)%
  - 16\* CNTL NODE ONE (NAME X(3))%
- 20\* CONTAINMENT DESCRIPTION (RECORD IN 15)%
  - 21\* C-LINE NUMBER (INTEGER 99 IN 20)%
  - 22\* CONTAINMENT DESC (NON-KEY CHAR X(50) IN 20)%
- 30\* GEOLOGY DESCRIPTION (RECORD IN 15)%
  - 31\* G-LINE NUMBER (INTEGER 99 in 30)%
  - 32\* GEOLOGY DESC (NON-KEY CHAR X(50) IN 30)%
- 40\* ORE MINERALOGY (RECORD IN 15)
  - 41\* ORE MINERAL (CHAR X(15) IN 40)%
  - 42\* ORE MINERAL PERCENTAGE (DECIMAL NUMBER 99.99 IN 40)%
- 100\* STUDY (RECORD)%
  - 101\* TITLE (CHAR X(250) IN 100)%
  - 102\* AUTHOR (CHAR X(20) IN 100)%
  - 103\* PUBLICATION DATE (INTEGER 9999 IN 100)%
  - 104\* NUMBER OF SAMPLES ( INTEGER 9(5) IN 100)%
  - 110\* BIBLIOGRAPHIC CROSS REFERENCE (RECORD IN 100)%
    - 111\* BIBLIOGRAPHIC SOURCE (CHAR X(10) IN 110)%
    - 112\* REFERENCE NUMBER (CHAR X(10) IN 110)%
  - 120\* C/N TWO (RECORD IN 100)%
    - 121\* CNTL NODE TWO (NAME X(3) IN 120)%

150\* STUDY DESCRIPTION (RECORD IN 120)%  
151\* S-LINE NUMBER (INTEGER 99 IN 150)%  
152\* STUDY DESC (NON-KEY CHAR X(50) IN 150)%  
  
200\* SAMPLE (RECORD IN 100)%  
201\* SAMPLE DATE (DATE IN 200)%  
202\* SAMPLE TIME (INTEGER 9999 IN 200)%  
203\* SAMPLE IDENTIFER (NON-KEY CHAR X(15) IN 200)%  
204\* SAMPLE TYPE (INTEGER 9999 IN 200)%  
205\* SAMPLE DESCRIPTION (NON-KEY CHAR X(100) IN 200)%  
206\* EASTING (INTEGER 9(6) IN 200)%  
207\* NORTHING (INTEGER 9(7) IN 200)%  
209\* ZONE (INTEGER 99 IN 200)%  
  
300\* MEASUREMENT (RECORD IN 200)%  
301\* MEASUREMENT CODE (CHAR X(6) IN 300)%  
302\* QUALITY CODE (NON-KEY CHAR XX IN 300)%  
303\* VALUE (NON-KEY DECIMAL NUMBER 9(6).9(5) IN 300)%

DATA DICTIONARY

PAGE:

DATA ELEMENT: TAILINGS SITE

NUMBER: 1

ALIAS:

DATA GROUPS:

DATA ELEMENT

DESCRIPTION: A descriptive name for the particular tailing  
containment facility which distinguishes it from  
others connected to the same mill.

UNITS:

RANGE OF VALUES:

FORMAT: X(12)

EDIT RULES: Alphanumeric

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: MINE

NUMBER: 2

ALIAS:

DATA GROUPS:

DATA ELEMENT

DESCRIPTION: The name of the mine producing the tailings

UNITS:

RANGE OF VALUES:

FORMAT: X(10)

EDIT RULES: Alphabetic

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: OWNER

NUMBER: 3

ALIAS:

DATA GROUPS:

DATA ELEMENT

DESCRIPTION: The mining company which owns the mine.

UNITS:

RANGE OF VALUES:

FORMAT: X(15)

EDIT RULES: Alphabetic

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: PROVINCE

NUMBER: 4

ALIAS:

DATA GROUPS:

DATA ELEMENT

DESCRIPTION: The province the mine/tailings site is located in.

UNITS:

RANGE OF VALUES: 01-12 (01-NFLD, 02-PEI, 03-N.S., 04-N.B., 05-QUE,  
06-ONT, 07-MAN, 08- SASK, 09-ALTA, 10-B.C. 11-YK,  
12-NWT)

FORMAT: 99

EDIT RULES: Province must correspond to detailed sample  
location.

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: TAILINGS START DATE

NUMBER: 5

ALIAS:

DATA GROUPS:

DATA ELEMENT

DESCRIPTION: The date on which the tailings containment  
facility was opened.

UNITS:

RANGE OF VALUES: MMDDYY  
(99 99 99)

FORMAT: 9(6)

EDIT RULES: DD(01-31), MM (01-12) YY (00-99)

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: TAILINGS END DATE

NUMBER: 6

ALIAS:

DATA GROUPS:

DATA ELEMENT

DESCRIPTION: The date on which the tailings containment  
facility was closed.

UNITS:

RANGE OF VALUES:

FORMAT: (See Tailings Start Date)

EDIT RULES: (See Tailings Start date)

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: TAILINGS AREA

NUMBER: 7

ALIAS:

DATA GROUPS:

DATA ELEMENT

DESCRIPTION: The total surface area of the tailings at the  
tailings site.

UNITS: hectares (ha)

RANGE OF VALUES: 000.00 - 999.99

FORMAT: 999.99

EDIT RULES: Numeric, positive

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: TAILINGS VOLUME

NUMBER: 8

ALIAS:

DATA GROUPS:

DATA ELEMENT

DESCRIPTION: The total volume of tailings in the containment facility.

UNITS: cubic metres (m<sup>3</sup>)

RANGE OF VALUES: 00000.0 - 99999.9

FORMAT: 9(5).9

EDIT RULES: Numeric, postive

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: MILL TYPE

NUMBER: 9

ALIAS:

DATA GROUPS:

DATA ELEMENT

DESCRIPTION: A code indicating the type of mill process used  
for uranium extraction.

UNITS:

RANGE OF VALUES: A - acid, B - alkali

FORMAT: X

EDIT RULES: Alphabetic

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: CONTAINMENT TYPE

NUMBER: 10

ALIAS:

DATA GROUPS:

DATA ELEMENT

DESCRIPTION: A code indicating the general type of containment facility for the tailings.

UNITS:

RANGE OF VALUES: A -valley dam      A- geological      A- soil  
B -ring dyke      B- clay      B- clay  
C -open pit      C- synthetic      C- water  
D -underground mine D- compacted soil D - synthetic  
E -deep lake disposal

FORMAT: XXX (General type, liner option, cover option)

EDIT RULES: Alphabetic

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: C/N ONE

NUMBER: 15

ALIAS:

DATA GROUPS: C/N ONE

DATA ELEMENT

DESCRIPTION: A repeating group created to facilitate retrievals  
at the study level.

UNITS:

RANGE OF VALUES:

FORMAT:

EDIT RULES:

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: CNTL NODE ONE

NUMBER: 16

ALIAS:

DATA GROUPS: C/N ONE

DATA ELEMENT

DESCRIPTION: A dummy entry to facilitate retrievals at the  
study level.

UNITS:

RANGE OF VALUES: "ONE"

FORMAT: XXX

EDIT RULES:

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT:      CONTAINMENT DESCRIPTION

NUMBER:    20

ALIAS:

DATA GROUPS:      C/N ONE

DATA ELEMENT

DESCRIPTION:      A repeating group for a description of the  
containment facility in terms of size, height,  
construction and other engineering features.

UNITS:

RANGE OF VALUES:

FORMAT:

EDIT RULES:

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: C-LINE NUMBER

NUMBER: 21

ALIAS:

DATA GROUPS: C/N ONE.CONTAINMENT DESCRIPTION

DATA ELEMENT

DESCRIPTION: A line number for each member of the containment  
description group.

UNITS:

RANGE OF VALUES: 00-99

FORMAT: 99

EDIT RULES:

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT:       CONTAINMENT DESC

NUMBER:   22

ALIAS:

DATA GROUPS:       C/N ONE.CONTAINMENT DESCRIPTION

DATA ELEMENT  
DESCRIPTION:       A description of the containment facility

UNITS:

RANGE OF VALUES:

FORMAT:            X(50)

EDIT RULES:

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: GEOLOGY DESCRIPTION

NUMBER: 30

ALIAS:

DATA GROUPS: C/N ONE

DATA ELEMENT  
DESCRIPTION:

A repeating group which summarizes the local  
surficial and sub-surface geology as it relates to  
the mine and mill site.

UNITS:

RANGE OF VALUES:

FORMAT:

EDIT RULES:

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: G-LINE NUMBER

NUMBER: 31

ALIAS:

DATA GROUPS: C/N ONE.GEOLOGY DESCRIPTION

DATA ELEMENT

DESCRIPTION: A line number for each member of the geology  
description group.

UNITS:

RANGE OF VALUES: 00-99

FORMAT: 99

EDIT RULES:

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: GEOLOGY DESC

NUMBER: 32

ALIAS:

DATA GROUPS: C/N ONE.GEOLOGY DESCRIPTION

DATA ELEMENT

DESCRIPTION: A description of the local surfical and subsurface  
geology.

UNITS:

RANGE OF VALUES:

FORMAT: X(50)

EDIT RULES: Alphanumeric

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: ORE MINERALOGY

NUMBER: 40

ALIAS:

DATA GROUPS: C/N ONE

DATA ELEMENT

DESCRIPTION: A repeating group describing the mineralogy of the  
ore being mined

UNITS:

RANGE OF VALUES:

FORMAT:

EDIT RULES:

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: ORE MINERAL

NUMBER: 41

ALIAS:

DATA GROUPS: C/N ONE.ORE MINERALOGY

DATA ELEMENT

DESCRIPTION: The name of the mineral in the ore

UNITS:

RANGE OF VALUES:

FORMAT: X(15)

EDIT RULES:

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: ORE MINERAL PERCENTAGE

NUMBER: 42

ALIAS:

DATA GROUPS: C/N ONE.ORE MINERALOGY

DATA ELEMENT

DESCRIPTION: The volume percentage of the mineral in the ORE.

UNITS:

RANGE OF VALUES: 00.00-99.99

FORMAT: 99.99

EDIT RULES: Numeric

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: STUDY

NUMBER: 100

ALIAS:

DATA GROUPS: STUDY

DATA ELEMENT

DESCRIPTION: A repeating group containing information specific  
to a given study.

UNITS:

RANGE OF VALUES:

FORMAT:

EDIT RULES:

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: TITLE

NUMBER: 101

ALIAS:

DATA GROUPS: STUDY

DATA ELEMENT

DESCRIPTION: This element contains the title or name of the study.

UNITS:

RANGE OF VALUES:

FORMAT: X(250)

EDIT RULES: Alphanumeric

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: AUTHOR

NUMBER: 102

ALIAS:

DATA GROUPS: STUDY

DATA ELEMENT

DESCRIPTION: This element contains the main author's name (of  
the study)

UNITS:

RANGE OF VALUES:

FORMAT: X(20)

EDIT RULES: Alphabetic

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: PUBLICATION DATE

NUMBER: 103

ALIAS:

DATA GROUPS: STUDIES

DATA ELEMENT

DESCRIPTION: The year in which the study was published or released.

UNITS:

RANGE OF VALUES:

FORMAT: 9999

EDIT RULES: Numeric, positive

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT:       NUMBER OF SAMPLES

NUMBER: 104

ALIAS:

DATA GROUPS:       STUDY

DATA ELEMENT

DESCRIPTION:       The number of samples collected in the study

UNITS:

RANGE OF VALUES: 0 - 99999

FORMAT:            9(5)

EDIT RULES:        Numeric, positive

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: BIBLIOGRAPHIC CROSS REFERENCE

NUMBER: 110

ALIAS:

DATA GROUPS: STUDY

DATA ELEMENT

DESCRIPTION: A repeating group indicating the source and  
reference number in another bibliographic index.

UNITS:

RANGE OF VALUES:

FORMAT:

EDIT RULES:

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: BIBLIOGRAPHIC SOURCE

NUMBER: 111

ALIAS:

DATA GROUPS: STUDY.BIBLIOGRAPHIC CROSS REFERENCE

DATA ELEMENT

DESCRIPTION: The name of the bibliographic index system  
containing a reference to the study.

UNITS:

RANGE OF VALUES:

FORMAT: X(10)

EDIT RULES: Alphanumeric

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: REFERENCE NUMBER

NUMBER: 112

ALIAS:

DATA GROUPS: STUDY.BIBLIOGRAPHIC CROSS REFERENCE

DATA ELEMENT

DESCRIPTION: The reference number in the bibliographic source  
for the study.

UNITS:

RANGE OF VALUES:

FORMAT: X(10)

EDIT RULES: Alphanumeric

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: C/N TWO

NUMBER: 120

ALIAS:

DATA GROUPS: C/N TWO

DATA ELEMENT  
DESCRIPTION:

A repeating group created to facilitate retrievals  
at the study level.

UNITS:

RANGE OF VALUES:

FORMAT:

EDIT RULES:

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: CNTL NODE TWO

NUMBER: 121

ALIAS:

DATA GROUPS: STUDY.C/N TWO

DATA ELEMENT

DESCRIPTION: A dummy data element to facilitate retrievals at  
the study level.

UNITS:

RANGE OF VALUES: "TWO"

FORMAT: XXX

EDIT RULES:

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: STUDY DESCRIPTION

NUMBER: 150

ALIAS:

DATA GROUPS: STUDY.STUDY DESCRIPTION

DATA ELEMENT  
DESCRIPTION:

A repeating group containing a narrative  
description of the study.

UNITS:

RANGE OF VALUES:

FORMAT:

EDIT RULES:

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: S - LINE NUMBER

NUMBER: 151

ALIAS:

DATA GROUPS: STUDY.STUDY DESCRIPTION

DATA ELEMENT

DESCRIPTION: A line number for each member of the study  
description group.

UNITS:

RANGE OF VALUES: 00-00

FORMAT: 99

EDIT RULES: Numeric, positive

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: STUDY DESCRIPTION

NUMBER: 152

ALIAS:

DATA GROUPS: STUDY.STUDY DESCRIPTION

DATA ELEMENT  
DESCRIPTION:

A narrative description of the study including  
methodology, purpose, types of samples and types  
of analysis.

UNITS:

RANGE OF VALUES:

FORMAT: X(50)

EDIT RULES: Alphanumeric

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT:      SAMPLE

NUMBER:    200

ALIAS:

DATA GROUPS:      STUDY.SAMPLE

DATA ELEMENT

DESCRIPTION:      A repeating group containing all the information  
                         at the sample level.

UNITS:

RANGE OF VALUES:

FORMAT:

EDIT RULES:

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: SAMPLE DATE

NUMBER: 201

ALIAS:

DATA GROUPS: STUDY.SAMPLE

DATA ELEMENT

DESCRIPTION: The date on which the sample was taken.

UNITS:

RANGE OF VALUES: MMDDYY

FORMAT: X (99 99 99)

EDIT RULES: MM(01-12), DD(01-31), YY(00,99)

SOURCE:

## DATA DICTIONARY

PAGE:

DATA ELEMENT: SAMPLE TIME

NUMBER: 202

ALIAS:

DATA GROUPS: STUDY.SAMPLE

DATA ELEMENT

DESCRIPTION: The time of day when the sample was taken.

UNITS: hours, minutes

RANGE OF VALUES: 0000 - 2400

FORMAT: 9(4)

EDIT RULES: hh - 00 to 24, mm - 00 to 60

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: SAMPLE IDENTIFIER

NUMBER: 203

ALIAS:

DATA GROUPS: STUDY.SAMPLE

DATA ELEMENT

DESCRIPTION: A field or laboratory sample identifier which  
could also identify the laboratory doing the  
analysis.

UNITS:

RANGE OF VALUES:

FORMAT: X(15)

EDIT RULES: Alphanumeric

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: SAMPLE TYPE

NUMBER: 204

ALIAS:

DATA GROUPS: STUDY.SAMPLE

DATA ELEMENT

DESCRIPTION: A code indicating the type of sample material.

UNITS:

RANGE OF VALUES: 0000-9999

FORMAT: 9999

EDIT RULES: Numeric, positive

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: SAMPLE DESCRIPTION

NUMBER: 205

ALIAS:

DATA GROUPS: STUDY.SAMPLE

DATA ELEMENT  
DESCRIPTION: A brief description of the sample material

UNITS:

RANGE OF VALUES:

FORMAT: X(100)

EDIT RULES: Alphanumeric

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: EASTING

NUMBER: 206

ALIAS:

DATA GROUPS: STUDY.SAMPLE

DATA ELEMENT

DESCRIPTION: The UTM easting coordinate of the sample location

UNITS: metres

RANGE OF VALUES: 000,000-500,000

FORMAT: 9(6)

EDIT RULES: Numeric

EOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT:       NORTHING

NUMBER:   207

ALIAS:

DATA GROUPS:       STUDY.SAMPLE

DATA ELEMENT

DESCRIPTION:       The UTM northing coordinate of the sample location

UNITS:             metres

RANGE OF VALUES:   0000000-99999999

FORMAT:            9(7)

EDIT RULES:        Numeric

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: ZONE

NUMBER: 208

ALIAS:

DATA GROUPS: STUDY.SAMPLE

DATA ELEMENT

DESCRIPTION: The UTM zone coordinate of the sample location.

UNITS:

RANGE OF VALUES: 00-16

FORMAT: 99

EDIT RULES: Numeric

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: DEPTH

NUMBER: 209

ALIAS:

DATA GROUPS: STUDY.SAMPLE

DATA ELEMENT

DESCRIPTION: The depth of the sample from the surface.

UNITS: metres

RANGE OF VALUES: 00.00-99.99

FORMAT: 99.99

EDIT RULES: Numeric, positive

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: MEASUREMENT

NUMBER: 300

ALIAS:

DATA GROUPS: STUDY.SAMPLE.MEASUREMENT

DATA ELEMENT

DESCRIPTION: A repeating group containing all the measurement  
information for a sample.

UNITS:

RANGE OF VALUES:

FORMAT:

EDIT RULES:

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: MEASUREMENT CODE

NUMBER: 301

ALIAS:

DATA GROUPS: STUDY.SAMPLE.MEASUREMENT

DATA ELEMENT  
DESCRIPTION:

A code indicating the type of measurement,  
analytical method, sample treatment, accuracy and  
units.

UNITS:

RANGE OF VALUES:

FORMAT: X(60)

EDIT RULES:

SOURCE:

The codes used in the NAQUADAT system in  
Environment Canada are suggested as a good  
starting point.

DATA DICTIONARY

PAGE:

DATA ELEMENT:      QUALITY CODE

NUMBER:    302

ALIAS:

DATA GROUPS:      STUDY.SAMPLE.MEASUREMENT

DATA ELEMENT

DESCRIPTION:      A code indicating the quality of the measurement  
value.

UNITS:

RANGE OF VALUES:

FORMAT:            XX

EDIT RULES:

SOURCE:

DATA DICTIONARY

PAGE:

DATA ELEMENT: VALUE

NUMBER: 303

ALIAS:

DATA GROUPS: STUDY.SAMPLE.MEASUREMENT

DATA ELEMENT

DESCRIPTION: The value of the measurement in the units  
indicated in the measurement code.

UNITS:

RANGE OF VALUES:

FORMAT: 9(6).9(5)

EDIT RULES:

SOURCE:

### 3. RECOMMENDATIONS

This section of the report will describe the recommendations for the creation and usage of the NUTP data base. These recommendations derive primarily from the interviews but also from literature review and personal observations and experience.

The recommendations will be discussed under two main headings: Implementation and Usage.

#### Implementation

1. For the successful implementation of the NUTP data base the organization responsible for the creation and maintenance of the data base should include a data base administrator.

This person would be responsible for the quality and integrity of the data base and revisions to any reports, documentation, codes or other data base related activities. This person should report to and be a member of the NUTP coordination committee.

2. To ensure the cooperation of the potential suppliers of the information to the data base, the data entry and conversion procedures should be the responsibility of the NUTP. At least initially, and for historical data, this would mean that special conversion programs would be needed for existing files of information until such times as an agreed standard format for data collection was established.

The question of standards concerns not only the format but the structure of the codes for classification of items like sample type, containment type, etc. Getting agreement on such classifications is very difficult and could take many months of hard work to define. Fortunately much of the work with respect to water quality analyses in NAQUADAT can be used in the NUTP database.

3. It should be emphasized that the data entry and conversion process is critical to the quality of the data base and thus, ultimately, its usefulness. Therefore the data entry and verification must be carried out by people with sufficient training in science or engineering to be able to interpret the data. This is a very costly activity, particularly when working from original source documents.
4. A prototype approach is suggested for the development of the data base to allow the potential users an opportunity to provide feedback without committing large amounts of time and money to a system which will certainly need refinement as it develops.

Another reason for this approach is that there are still a lot of unanswered questions with respect to the processes associated with uranium tailings and the movement of contaminants in the environment. The key variables to be measured have not been unequivocally identified nor are either the short term or the long term behaviour of contaminants well understood. This is particularly true for the long term behaviour of radionuclides.

5. It is necessary to try and define more precisely the relationship between the data base and the development and evaluation of dosage models within the National Uranium Tailings Program before proceeding beyond a pilot or prototype database. The High Level Nuclear Waste Management Program may provide some valuable examples in this area.
6. Some of the problems that will need to be addressed during the next study are: where all the data will be coming from, how data much is there, what form is it in, what is the technical feasibility of gathering and/or converting it and who will do the work of collecting it, verifying it and entering it. Once all of these questions have been answered the question of costs and charges can be addressed.
7. Following this study it is recommended that:
  - a) the proposed data base structure and content be reviewed by the potential user community, including a brief description of S2K and its features;
  - b) a NUTP coordinating committee be established and a data base administrator selected to oversee the implementation of the data base;
  - c) a study be conducted to identify and document the existing sources of data and volumes of data available for inclusion in the data base;
  - d) the data administrator establish a subcommittee to determine what new coding structures should be created and what extensions are needed to coding structures currently in use in other environmental data bases;

- e) negotiations be started with the Federal Department of the Environment and Atomic Energy of Canada Ltd. to acquire copies of their software for the NAQUADAT data base and the dosage models, respectively. By following this route, one may build easily and at relatively low cost on the experience of these other groups. The ESQUADAT system is a variation of NAQUADAT and should also be examined for its specific differences.

## Usage

1. A data base on uranium mine tailings can and must serve several functions. Within the context of the National Uranium Tailings Program (NUTP) the data base must contain the parameters and data to support the dosage models as well as providing a source of field observations for verifying the models. For researchers the data base can provide a bibliography of studies related to Uranium Mine Tailings and be a source of "data about data", i.e. what kinds of data are available of a specific kind in a specific area. As part of the model development process the data base can be a valuable source of data for multivariate statistical analysis and the search for meaningful relationships among the variables. To attempt to have the data base fulfill all of these functions in the initial stages of development would be very difficult as the interaction between the data base and the modelling efforts is evolutionary and interactive.
2. As a first step, gathering the source documents of studies into the data base as an extended bibliography (perhaps using MINTEC as a starting point) would satisfy several requirements. In parallel with this activity the development of codes and standards for the raw data and derived parameters can proceed. There are some existing data bases which can provide valuable examples of how the problems of coding and standards can be approached. The Mineral Data Bank and the Canada Centre for Geoscience Data's GEOSCAN database within EMR and the NAQUADAT system at Environment Canada can all provide guidance on how to approach these problems although the NUTP is potentially much more complex and ambitious in its objectives.

Completion of this first step would quickly demonstrate the concept of a NUTP database and encourage further development.

3. Another important aspect of usage is access control. Many of those interviewed would like to have on-line access for low volume queries (i.e. less than 1 page) as well as batch capabilities for larger reports. Access to published information presents no problems but some of the "available, but unpublished" material should be released only to those having a legitimate need to use the data. This can be controlled by passwords on selected portions of the data base and a process for screening requests through the NUTP data base administrator.
4. A feature that was considered very useful was a graphical output facility for producing maps and charts showing the distribution and range of the data in the data base as well as more traditional tables and reports.

Some of the companies indicated that this feature would be useful for regulatory reporting as well as it would reduce their effort for duplicate reporting.

5. In the longer term the NUTP should consider a system for manipulating models and comparing results from different models with each other and with historical data. What would be required is a "database of models" enabling a user to experiment and investigate the features of the models and the impact of changes in parameters stored in the data base.

6. Several of those interviewed were very concerned about the mechanics of supplying information to and retrieving information from the database, particularly since the majority of potential users are not in Ottawa and do not necessarily have CDC computers.

To be responsive to these needs the interface to the database needs to be sensitive to that worry, accept a variety of input formats and provide a variety of outputs. On-line access to the database will be very important to the success of the database.

7. Since many of the potential users are not computer specialists it will be necessary to have simple procedures and training developed as part of the system development and documentation. A system that isn't easy to use won't get used.

Also because the data base is multidisciplinary in nature it would be very useful to develop a glossary to accompany the data dictionary.

8. The question of inclusion of regulatory levels within the data base itself was raised but no one seemed to have strong opinions about it. Therefore the recommendation is that they be excluded a) because they aren't wanted strongly enough and, b) because they are likely to change over time both in level and constituent.

9. Some assorted other features which were mentioned during the interviews as being useful were: a) a set of test cases for verifying models of various types, b) a regular directory published on the types of data in the database, and c) a summarizing capability for producing basic statistics on selected data elements. These latter two features are readily available in the System 2000 database package.

APPENDIX A

LIST OF INTERVIEWS

(in alphabetical order)

A.W. Ashbrook, Eldorado Nuclear Ltd.  
S.L. Barbour, Clifton Associates Ltd.  
R. Bachelor, Saskcomp  
W.B. Blakeman, Environment Canada  
K. Bragg, Atomic Energy Control Board  
C.H. Burton, Saskatchewan Mining Development Corp.  
M. Campbell, Canada Centre for Mineral and Energy Technology  
E.M. Cook, Gulf Minerals Canada Ltd.  
N. Davé, Canada Centre for Mineral and Energy Technology  
J.H. Dyck, Saskatchewan Research Council  
D. Ellwood, Geological Survey of Canada  
J. Fitzgibbon, University of Saskatchewan  
V. Haw, Canada Centre for Mineral and Energy Technology  
J.R. Hawley, Ontario Ministry of the Environment  
H. Horn-Johnson, Saskatchewan Environment  
J. Hayward, Saskatchewan Environment  
H. Heuser, P. Machibroda Engineering Ltd.  
J. Hnatiuk, ID Systems Ltd.  
J. Howieson, Canada Centre for Mineral and Energy Technology  
A. W. James, Ontario Ministry of the Environment  
M. Kalin, Institute for Environmental Studies  
D.W. Lawson, Environment Canada  
T.P. Lim, Canada Centre for Mineral and Energy Technology  
R. Lyon, Atomic Energy of Canada Ltd.  
P. Machibroda, P. Machibroda Engineering Ltd.  
W.A. Meneley, W.A. Menelely Consultants Ltd.  
H. Maathius, Saskatchewan Research Council  
D. Moffett, Eldorado Nuclear Ltd.

E. Muller, Environment Canada  
D.R. Murray, Canada Centre for Mineral and Energy Technology  
C. McFarlane, Ontario Ministry of the Environment  
C. McKenzie, Saskatchewan Research Council  
M.G. Never, Key Lake Mining Ltd.  
N. Parchewsky, Reid, Crowther and Partners Ltd.  
C. Potter, Saskatchewan Environment  
T. Pounder, Computeristics Ltd.  
P.L. Reeves, Saskatchewan Mineral Resources  
G. Ritcey, Canada Centre for Mineral and Energy Technology  
E.K. Sauer, University of Saskatchewan  
W. Sawchyn, Saskatchewan Research Council  
B. Schreiner, Saskatchewan Research Council  
A. Schreive, Beak Consultants Ltd.  
K.H. Scissons, Saskatchewan Environment  
J.S. Scott, Environment Canada  
M. Silver, Canada Centre for Mineral and Energy Technology  
J. Skeaff, Canada Centre for Mineral and Energy Technology  
Y.M. Sleyphen, Canada Centre for Mineral and Energy Technology  
P. Sutterlin, Canada Centre for Mineral and Energy Technology  
S. Swanson, Saskatchewan Research Council  
P. Tones, Saskatchewan Research Council  
D. Troubridge, MacLaren Plansearch Services Ltd.  
A.J. Vivyurka, Rio Algoma Ltd.  
R. Webber, Denison Mines Ltd.  
E. Wheaton, Saskatchewan Research Council  
J. Whiting, Saskatchewan Research Council  
S.H. Whitlow, Environment Canada  
J. Witteman, Environment Canada

## APPENDIX B

### LIST OF REFERENCES

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R.B. Lyon  
AECL  
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Tucson, Arizona, 1981
21. Phil Reeves, Saskatchewan Geological Survey, Selected  
articles from Summary of Investigations, 1978.
22. Kevin H. Scissons, Saskatchewan Environments' ESQUADAT  
Computerized Data System, personal communication.
23. Harm Maathuis, Saskatchewan Research Council, Selected  
material on the water quality data base in Saskatchewan,  
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24. Elaine Wheaton, Saskatchewan Research Council, Selected  
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Province of Ontario, 1980  
John R. Hawley,  
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Ontario Ministry of the Environment

APPENDIX C

STATEMENT OF WORK

## CONTRACT

TITLE: The Design of a Machine-readable File of Uranium Tailings Data

REQUIREMENT: The initial requirement in the development of a uranium tailings database containing information and quantitative data about the contained radionuclides is to determine the form and content of the file.

BACKGROUND: An ad hoc Committee, called by CANMET under the National Tailings Program and which includes representatives of Federal and Provincial governments, Crown Corporations, Industry and Universities has produced a document recommending research amounting to \$18,000,000 funded jointly by the Federal Government and the Provinces into the problems of Uranium Tailings. The present proposal has been precipitated by the fact that agreement has been reached by the Federal Government and the Province of Saskatchewan, and as early a start as possible on the program is desired.

### STATEMENT OF WORK:

PHASE I: The development, as the first step in meeting the initial requirement above, of standard for the content and form of the uranium tailings file. The form must be compatible with the specifications of the SYSTEM 2000 Data Base Management System (SYSTEM 2K) which is implemented and supported by the Computer Science Centre, Energy Mines and Resources, 588 Booth Street, Ottawa, using a CDC Cyber computer. This is to be accomplished as follows:

1. Determination of items of data and information to be included in the database, based on consultation with persons on the attached list.
2. Determination of the basic unit (or entity) of the file, taking into account as far as possible the forms of output required, the nature of any data which may be added to the file at a later time, and the SYSTEM 2K Data Manipulation Language.

3. Establishment of the form in which individual items of data are to be recorded and linked, insuring that all items of data which may be potentially used as retrieval "keys" are defined.
4. Establishment of systems of codes and/or acronyms where desirable or necessary in order to record individual items or qualitative data in a consistent manner.
5. Establishment of a range of permissible values where applicable to individual items of quantitative data, the ranges to be incorporated in the Data Dictionary.
6. Preparation of a report which describes the proposed database in terms of the SYSTEM 2K Data Definition Language (i.e. the logical data structure) and accompanied by a Data Dictionary.

EFFECTIVE CONTRACT COMMENCEMENT DATE: On date of contract award.

EFFECTIVE CONTRACT TERMINATION DATE: March 31, 1982

REPORTS/DELIVERY: Ten copies of a final report are to be submitted to the Scientific Authority at least five days prior to the contract termination date.

SCIENTIFIC AUTHORITY: P.G. Sutterlin  
Office of Technology Transfer,  
CANMET, Energy, Mines and Resources Canada  
Room 346, 555 Booth Street  
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